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## ACANTHOCEPHALA OF THE SUBFAMILY RHADINORHYNCHINAE FROM AMERICAN FISH\*

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But two species of Acanthocephala have, to the present time, been definitely ascribed to the genus Rhadinorhynchus. *Echinorhynchus pristis* Rud. was the original species for which Lühe (1911) created this genus. One year later he added another species to the genus by his description of *R. horridus* from Egypt. The older species has been reported as parasitic in fishes from various parts of the world. The descriptions given in these scattered reports differ so radically that it seems improbable that they could all apply to a single species. Here, as in other genera of Acanthocephala, it seems obvious that the older workers, recognizing the cardinal points which in modern classification have been accepted as indicative of generic value, have failed to observe the less obvious, though significant, differences which serve to separate species. Thus all members of the present genus Rhadinorhynchus have been identified as *E. pristis*, and the descriptions have usually been inadequate to enable more recent workers to recognize the same forms if encountered again. In some few instances the descriptions have been complete enough to permit one to recognize the forms described. Linton's work on *E. pristis* is of the type last mentioned.

In 1891 Linton recorded the occurrence of Acanthocephala which were at least similar to *E. pristis* from the intestine of *Tylosurus acus* (Lacép), and of *Lobotes surinamensis* (Bloch). After acknowledging "perplexity in attempting their identification," Linton tentatively ascribed some of his individuals to the species *E. pristis*, while others he referred to a new variety of that species. To the variety he gave the name *E. pristis tenuicornis*. In later work he remarked upon the presence in what he determined as *E. pristis* from fishes at Beaufort, N. C., of "a circle of hooks at the base of the proboscis which are longer than the other hooks" (Linton, 1908:89). This "circle" of hooks was briefly mentioned in an earlier paper (1892:531). In materials studied by the present writer, the spines at the base of the proboscis, though not forming a circle, are very conspicuous. After a comparison of these specimens with data given by Linton the writer is convinced that Linton was at various times dealing with at least two distinct species of the genus Rhadinorhynchus to which he gave

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reference as *E. pristis* and *E. pristis tenuicornis*. Further evidence of this will be presented in a later part of this paper.

In later works Linton described two additional species of Acanthocephala, *Echinorhynchus sagittifer* and *E. medius*, both of which obviously belong near to the genus *Rhadinorhynchus*. The former of these has been referred to Monticelli's genus *Echinogaster*, and in the present paper the writer includes the species *medius* in the genus *Rhadinorhynchus*. The records mentioned above constitute the only cases of *Rhadinorhynchus*-like forms reported from North America.

TABLE 1  
COMPARISON OF *R. PRISTIS* WITH AMERICAN SPECIES OF RHADINORHYNCHINAE

Form	Proboscis Hooks		Body Spines		Embryos
	Number	Size	Arrangement	Size	
<i>R. pristis</i> (Rud) of Lühe, 1911	14 longit. rows of 26 hooks each	85 $\mu$ *	Scattered in two fields	110 $\mu$ *	95 $\times$ 17 $\mu$
<i>R. ornatus</i> n.sp. ( <i>E. pristis</i> of Linton, 1892)	About 24 longit. rows of about 40 hooks each.	50-80 $\mu$	Scattered	80 $\mu$	60 $\mu$ long.
<i>R. tenuicornis</i> n.sp. ( <i>E. p. tenuicornis</i> of Linton, 1892)	14 longit. rows of about 26 hooks each; crescent of spines at base of proboscis	♀40-80 $\mu$ ♂20 $\mu$ +	Scattered	♀60-80 $\mu$ ♂28 $\mu$ +	60 to 80 $\mu$ by 12 $\mu$
<i>R. medius</i> (Linton, 1905)	About 22 longit. rows of about 20 hooks each	45-60 $\mu$	Scattered	30-45 $\mu$	75 $\times$ 24 $\mu$
<i>Echinogaster sagittifer</i> (Linton)	About 24 longit. rows of 15-18 hooks each	80 $\mu$	Collar of scattered spines followed by 18-23 ventral cross rows	Collar 50-60 $\mu$ Ventral rows 60-70 $\mu$	?

\*Unfortunately Lühe has not given measurements of the hooks or body spines of *R. pristis*. The measurements given for *R. pristis* above are approximations obtained by finding the values for these structures on the basis of the magnification given with his figures. These can serve as mere approximations, for in checking over other drawings in the same article considerable error in magnification has been found. For example, 95 $\mu$  is the length given in the text for the embryos of *R. pristis*, while application of stated magnification to the embryo figured gives a value of but 83 $\mu$  for the length. Embryos usually vary some in length but Lühe's failure to state the range of variability in his measurements makes it impossible to calculate the probable error in his magnification.

Table 1 lists the points of difference and similarity between the forms dealt with in this paper. The writer has created a new species, *Rhadinorhynchus ornatus*, for the forms described by Linton as *E. pristis*. Specimens from the U. S. National Museum, examined by the writer, are apparently identical with Linton's *E. pristis tenuicornis*. After a careful study of these specimens, results of which have added some new data to our knowledge of the structure of the form, the writer has given a description of a new species, *Rhadinorhynchus tenuicornis*. In this connection it is interesting to note that

of the Rhadinorhynchinae but one species is known to Europe and one to Africa, while from the American continent four species representing two genera are now reported.

#### Genus RHADINORHYNCHUS Lühe 1911

Synonym: *Echinosoma* Porta 1907 (preoccupied), in part.

*Generic Diagnosis.*—Acanthocephala parasitic as adults in the intestine of fish. Anterior body region armed with scattered cuticular spines, ensheathed by cuticular folds. Proboscis and proboscis receptacle very long. Ventral proboscis hooks stronger than dorsal. Proboscis receptacle a two-walled muscular sac with the brain located near its middle. Lemnisci long, fingerlike.

Porta (1907:412) gave the name *Echinosoma* to a new genus of Acanthocephala which he created to include: *E. gibber* Olss., *E. vasculosus* Rud., *E. miliarius* Zenk., *E. roseus* Mol., *E. pristis* Rud., and several other species. The name *Echinosoma* is preoccupied and is for that reason not available for this group of Acanthocephala. Furthermore, the forms listed by Porta constitute a heterogeneous group which have but little in common aside from the presence of spines on the body. No species was cited as type of Porta's *Echinosoma*. On the other hand the first species mentioned in his list was *E. gibber* Olss. which has been quite commonly regarded as a synonym for *E. strumosus*. In 1904 Lühe created the genus *Corynosoma* with *C. strumosum* as type by original designation. Subsequently a number of new genera have been created which include species cited by Porta for his now disrupted genus *Echinosoma*. *Rhadinorhynchus* Lühe 1911, with *R. pristis* (Rud.) as type species, is one of this number. Consequently, *Echinosoma* Porta 1907 in part, must be regarded as a synonym of *Rhadinorhynchus* Lühe 1911.

#### *Rhadinorhynchus ornatus* nov. spec.

Synonym: *E. pristis* Rud. of Linton, 1892 and 1908. Text figure A.

*Specific Definition.*—With the characters of the genus *Rhadinorhynchus*, Lühe, 1911. Proboscis armed with from twenty-two to twenty-four longitudinal rows of about forty hooks each. Hooks on proboscis ranging from 50 to 80 $\mu$  in length. Anterior body region armed with scattered cuticular spines about 80 $\mu$  long. Embryos about 60 $\mu$  long.

Host: *Tylosurus acus* (Lacép.), Woods Hole, Mass.

The above definition is adapted from the original description by Linton.

*Rhadinorhynchus tenuicornis* nov. spec.

Synonym: *E. pristis tenuicornis* Linton, 1892. Figures 1 to 4 and text figure B.

The variety *Echinorhynchus pristis tenuicornis* created by Linton (1892), for what he considered a variety of the European species *E. pristis*, is clearly a distinct species. Table 1 presents the evidence of the distinctness of this and other forms dealt with in this paper. In elevating the variety to specific rank the writer has used the varietal name for the name of this species. Data given by Linton in his original description of the variety omitted several characteristics which are useful in drawing a closer limitation of the species. Fortunately, the present writer has had access, through the government collections, to additional specimens which in all essential details agree with Linton's description. A study of these specimens has made it possible to offer here a more complete description of *R. tenuicornis*.

*Specific Definition.*—With the characters of the genus *Rhadinorhynchus*. Proboscis armed with ten to fourteen longitudinal rows of approximately twenty-six hooks each. Proboscis hooks of female 40 to 80 $\mu$  long; of male near base may be as small as 20 $\mu$ . A conspicuous crescent of about seven long hooks on the ventral side of the proboscis at the region between neck and proboscis. Body spines of female 60 to 80 $\mu$ , of male about 28 $\mu$ . Embryos inside body cavity of female 60 to 80 $\mu$  long and 12 $\mu$  wide, with middle membrane drawn out into attenuated polar capsules.

*Hosts:* *Tylosurus acus* and *Lobotes surinamensis* at Woods Hole, Mass., and "trout" at Baltimore, Md. The collection of specimens from this last host was made by Hassall in October, 1891. Specimens are on deposit in the Hassall collection of the U. S. National Museum, catalog number 6324.

The anterior body region in this species, especially among the females, tapers considerably to reach the size of the proboscis at the point of insertion with the proboscis receptacle. In many specimens the extremely long proboscis and the anterior region of the body are withdrawn within the body. The proboscis receptacle is so long that in retracting the inverted proboscis toward its base much of the anterior body region also becomes inturned. Linton in 1891 and again in 1905 mentioned the "circle of prominent arcuate hooks" at the base of the proboscis. In *R. tenuicornis* the present writer has found a group of prominent hooks in the same locality, but they take the form of a crescent instead of that of a circle, since in their distribution they are restricted to the ventral surface of the proboscis. This arrangement in the form of a crescent is shown clearly even in specimens which have the proboscis and anterior body region inturned (Fig. 2).

These hooks differ in appearance from the remainder of the proboscis hooks and also differ from the body hooks. They present a peculiar granular appearance in stained whole mounts.

*Rhadinorhynchus medius* (Linton)

Synonym: *Echinorhynchus medius* Linton, 1908.

This species was described by Linton (1908:88) from Bermuda fishes. In his description he called attention to the fact that "this species is near *E. pristis*, in external appearances," but in listing the points of difference he omitted several of the most essential. The present writer has reexamined the type material deposited in the U. S. National Museum and has been able to corroborate Linton's original description as far as it goes. A brief summary of the diagnostic characters of the species follows:

*Specific Definition.*—With the characters of the genus *Rhadinorhynchus*. Proboscis linear to fusiform, armed with about twenty-two longitudinal rows of about twenty hooks each. Hooks near base (basal two or three of each row) about  $45\mu$  long, remainder of hooks fairly uniform in size, about  $60\mu$  long. Hooks deeply embedded in cuticula, recurved, stout. Neck smooth, conical. Body spines 30 to  $45\mu$  long; extend on ventral side of body from just back of neck to about one-third the length of the proboscis receptacle; on dorsal surface extend only about one-half the distance of ventral. Embryos  $75\mu$  long by  $24\mu$  wide.

*Host:* *Mycteroperca apua*, in intestine. Locality, Bermuda Islands. Larvae in cysts on viscera of various fishes. Types deposited by Linton in U. S. National Museum, catalog number 5796.

Genus ECHINOASTER Monticelli 1905

Synonyms: *Echinorhynchus* in part. *Echinosoma* Porta, 1907, in part.

Monticelli (1905:11) in a footnote created the genus *Echinogaster* giving a six-word diagnosis and designating no type for this or for either of the other two genera (*Pomphorhynchus* and *Chentrosoma*) created at the same time. Porta (1907:413) reduced *Echinogaster* to a subgenus of his newly created genus *Echinosoma*, and referred *E. sagittifer* of Linton to *Echinogaster*. The name *Echinosoma* is preoccupied and can consequently not be accepted as a name for Porta's genus. Furthermore, the present writer is definitely of the opinion that the genus *Echinogaster* was erroneously reduced to subgeneric rank, and here proposes elevating it again to full generic standing. Lühe (1912:278) called attention to the close relationship which exists between members of the genera *Rhadinorhynchus* and

Echinogaster and proposed that a new subfamily, the Rhadinorhynchinae, be erected in recognition of this fact. Many points in the structure of the members of the genus Echinogaster are unknown at the present time, consequently it seems advisable to offer as a generic diagnosis only those points which serve as a ready means of separating Echinogaster from Rhadinorhynchus. A more complete diagnosis can be given only upon a restudy of forms belonging to this genus.

*Generic Diagnosis.*—Rhadinorhynchinae with ventral cross rows of body spines.

*Echinogaster sagittifer* (Linton, 1889)

Synonyms: *Echinorhynchus sagittifer* Linton, 1889. *Echinosoma* (*Echinogaster*) *sagittifer* (Linton) Porta, 1907.

*Specific Definition.*—Rhadinorhynchinae with characters of the genus Echinogaster. Proboscis clavate, bluntly rounded in front, increasing slightly for a short distance back from the tip, then narrowing gradually to the base; armed with about twenty-four longitudinal rows of about fifteen to eighteen hooks each. Longest proboscis hooks about  $80\mu$  long. Body spines arranged in two distinct groups—a collar of spines 50 to  $60\mu$  long on the body region just behind the neck, and eighteen to twenty-three series of ventral transverse rows of spines each containing from six to twenty-four sagittate spines about 60 to  $70\mu$  long. Measurements of embryos not given.

*Host:* *Rachycentron canadus*, in intestine, at Beaufort, N. C. Larvae encysted in mesentery and viscera of various marine fishes.

Key to the species of Rhadinorhynchinae from American fish.

- 1 (6) Rhadinorhynchinae with scattered body spines.....2
- 2 (5) Body spines of females over  $60\mu$  long.....3
- 3 (4) Proboscis with less than sixteen longitudinal rows of hooks  
..... *Rhadinorhynchus tenuicornis*
- 4 (3) Proboscis with more than twenty longitudinal rows of hooks  
..... *Rhadinorhynchus ornatus*
- 5 (2) Body spines of female less than  $50\mu$  long.....  
..... *Rhadinorhynchus medius*
- 6 (1) Body spines on ventral surface arranged in cross rows....  
..... *Echinogaster sagittifer*

SUMMARY

A new species, *Rhadinorhynchus ornatus*, is created for *E. pristis* of Linton, 1891.

*Rhadinorhynchus tenuicornis* nov. spec. is created for Linton's variety *E. pristis tenuicornis*.

*Echinosoma* Porta, 1907, is preoccupied and in part is to be considered as a synonym of *Echinogaster* Monticelli, 1905.

*Echinorhynchus medius* Linton, 1908, is assigned to the genus *Rhadinorhynchus*.

A key is given to the *Rhadinorhynchinae* of America including three species of the genus *Rhadinorhynchus* and one species of *Echinogaster*.

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## EXPLANATION OF FIGURES

Text Figures A. and B. showing distinctive differences in proboscis armature of *R. ornatus* and *R. tenuicornis*.

(A.) *R. ornatus*, median region of proboscis of female;  $\times$  about 150. From Linton, 1891, Fig. 33.

(B.) *R. tenuicornis*, portion of proboscis of male,  $\times$  about 150. From Linton, 1891, Fig. 53.

## EXPLANATION OF PLATE

All drawings made with the aid of a camera lucida. Magnification is indicated by the reference line accompanying each figure which has the value of  $50\mu$ .

*Rhadinorhynchus tenuicornis* nov. spec.

Abbreviations used: *a*, anterior; *br*, brain; *lem*, lemnisci; *p*, posterior; *pr*, proboscis receptacle.

Fig. 1.—Anterior body region of male with partially inverted proboscis. Basal crescent of hooks is wanting in this specimen. The proboscis had been slightly damaged at the point where they should occur.

Fig. 2.—Optical section of female in anterior ventral region of body showing group of hooks at base of inverted proboscis.

Fig. 3.—Surface view of anterior body region of female with proboscis completely inverted.

Fig. 4.—Embryo from uterus of mature female.

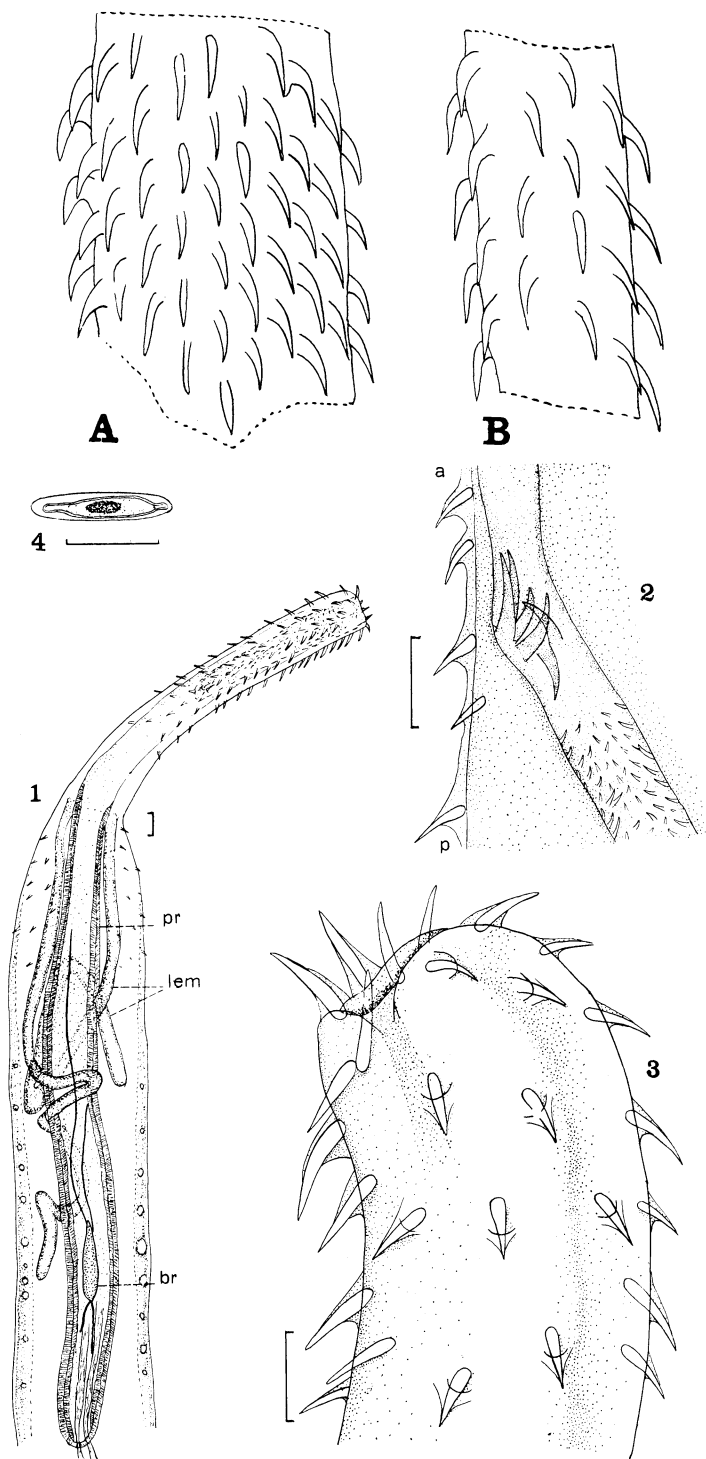


PLATE III